

## THE STATUS OF TWO CHILEAN FROGS OF THE GENUS *EUPSOPHUS* (ANURA: LEPTODACTYLIDAE)

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*Abstract.*—External and internal morphological features show that *Eupsophus calcaratus* (Günther, 1881) is a well defined species different from *E. roseus* (D. & B.), with which it was previously synonymized. *Eupsophus calcaratus* is re-described, and notes on its natural history are presented. *Eupsophus roseus insularis* (Philippi, 1902) is shown to be not conspecific with *E. roseus* and is re-described as *Eupsophus insularis*.

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Günther (1881) described *Cacotus calcaratus*, based on only one specimen from Chiloé Island (no precise locality). Boulenger (1882) transferred this species to the genus *Borborocoetes*, and Cei (1958), without an osteological study, concluded that the genera *Borborocoetes*, *Cystignathus*, and *Alsodes* were synonymous with the genus *Eupsophus*. A series of Lynch's papers (1971, 1972, 1978), which were based on osteology (especially the cranial bones), permitted the definition of *Eupsophus* in which two species were included, *E. vittatus* and *E. roseus*; *E. migueli* Formas, 1978, was not considered by that author. Cei (1958) and Capurro (1958) considered *E. calcaratus* a valid species, but they pointed out that the taxonomic status of this frog needed to be revised. Later, Cei (1960, 1962a, 1962b) and Grandinson (1961) discussed the taxonomy of *E. calcaratus* and concluded that the species was synonymous with *E. roseus* (D. & B.). Formas (1980) described the karyotype of frogs from Valdivia (Cordillera Pelada) and Osorno (La Picada) and the name *Eupsophus calcaratus* was used for these animals.

During our herpetological studies of Chiloé Island, Osorno, and Valdivia, one of us (JRF) collected frogs which agree with Günther's description and with the external morphology of the holotype. An osteological study (especially of cranial osteology) of the Chiloé Island frogs confirms that these animals should be included in the genus *Eupsophus* because they have the cranial pattern of *E. roseus*, the type species of the genus (see Lynch 1971). Both *E. roseus* and *E. calcaratus* have the frontoparietal fontanellae large, the sphenethmoid short and extending between the nasals, which are intermediate in size, separated medially; quadra-tojugal present; pars facialis of maxillary wide, and columella present.

*Eupsophus calcaratus* differs from *E. roseus* in the pigmentation of the upper part of the iris, the slope of the tips of toes and fingers, distance between prevomerine teeth, and shape of the dorsal and lateral snout profile.

Philippi (1902) described *Cystignathus (Borborocoetes) insularis* based on five specimens from Mocha Island, 38°22'S, 73°56'W, 40 km west of the coast of Arauco Province, Chile. Cei (1958) considered this species synonymous with *Eupsophus roseus*, and Capurro (1963), on the basis of only one female from the same island, concluded that Philippi's species was a subspecies of *Eupsophus grayi* and called the frog *Eupsophus grayi insularis*. We had the opportunity to

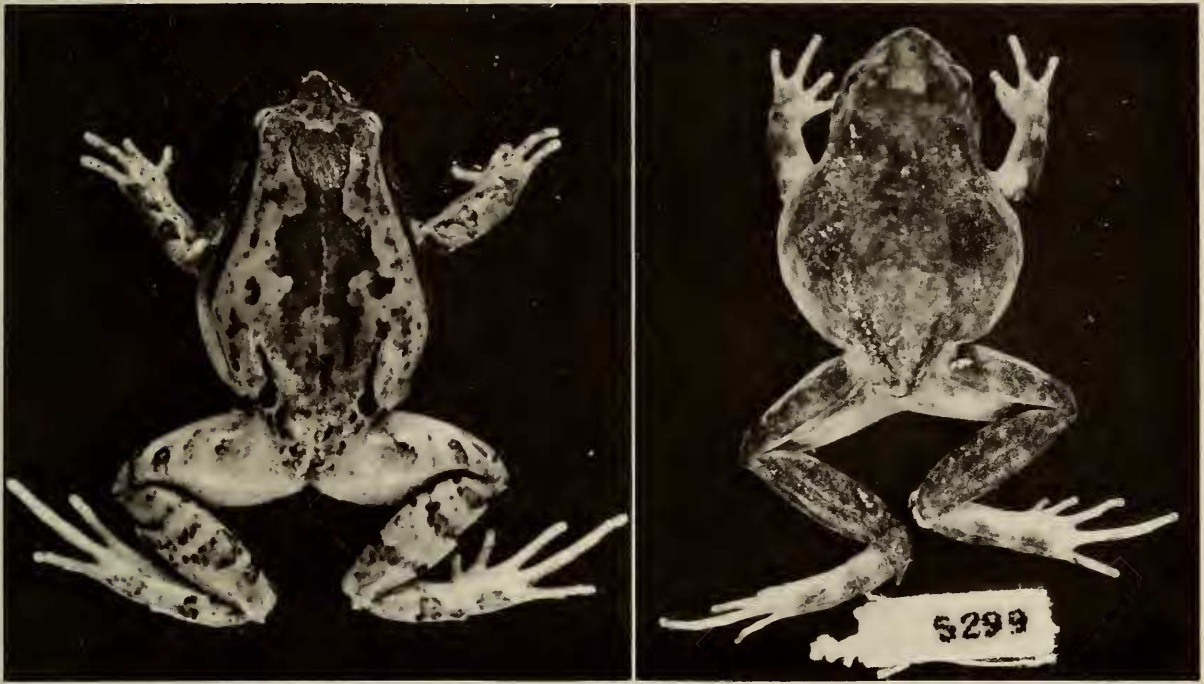


Fig. 1. Adult females of *Eupsophus calcaratus* from Puntra, Chiloé Island,  $\times 1.5$  (left), and *E. insularis* from Mocha Island,  $\times 1.2$  (right).

analyze three specimens (MUZUC 5256, 5299, 5309) from Mocha Island, courteously loaned by Jorge Artigas of the Instituto de Zoología, Universidad de Concepción. We consider that the form described by Philippi is a valid species because it differs from *E. roseus* in color pattern, shape of the xiphisternum, length of fingers and toes, and location of prevomerine teeth. The skull osteology permits inclusion of Philippi's taxon into the genus *Eupsophus* because it shares the cranial pattern of *E. roseus*.

*Eupsophus calcaratus* (Günther, 1881)

Fig. 1

*Cacotus calcaratus* Günther, 1881:19 (Holotype: BMNH 468, 68.9.22.8. Chile; type-locality: Chiloé Island).

*Borborocoetes calcaratus*.—Boulenger, 1882:256, pl. 17, Fig. 1.

*Cystignathus oxyglossus* Philippi, ?1902:110 (Chile; type-locality: eastern part of Chiloé Island).

*Cystignathus fernandezi* Philippi, ?1902:112 (Chile; type-locality: Chiloé Island).

*Eupsophus calcaratus*.—Capurro, 1958:293.—Ceï, 1958:270.—Formas, 1980:1163.

*Eupsophus grayi* Ceï, 1960:3; 1962:33.

*Eupsophus roseus* Grandinson, 1961:128.

*Diagnosis*.—*Eupsophus calcaratus* is a moderate sized species that can be distinguished from its congeners by the following combination of characters: 1) upper part of the iris bronze-yellow; 2) distal portion of the fingers and toes rounded and prominent; 3) prevomers in narrow contact; 4) snout pointed in dorsal and lateral view, noticeably protruding over the lower jaw.

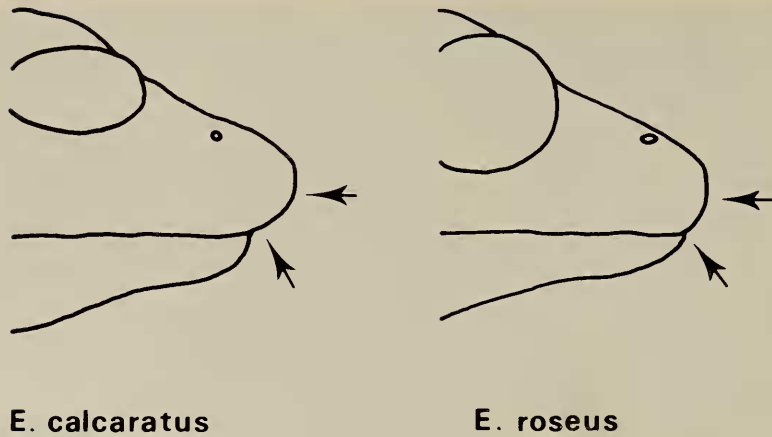


Fig. 2. Lateral profile of the snout of *Eupsophus calcaratus* and *E. roseus*.

*Description* (based on 25 living specimens and 31 fixed specimens).—Head wider than long. Snout pointed in dorsal view, rounded in lateral profile (Fig. 2); canthus rostralis well defined; loreal region concave, sloping slightly to lip; nostrils lateral, closer to tip of snout than to orbit; length of eye greater than distance between eye and nostril; interorbital distance slightly narrower than length of eye, greater than internarial distance. Tympanic membrane small and poorly defined, tympanum diameter smaller than eye diameter. Lateral fold present, from behind eye to middle part of body. Tongue rounded, slightly cordiform. Small round choanae; dentigerous process of prevomers lying slightly below choanae; closer medially, transverse or slightly oblique, each process bearing 4–6 teeth. Forelimbs thin, first finger equal in length to second; third finger much longer than fourth; digital length in decreasing order 3–4–2–1. Tips of fingers rounded and slightly prominent (Fig. 3). Two palmar tubercles ovoid and prominent; sub-articular tubercles rounded and moderate prominent; supernumerary palmar tubercles absent. Hind limbs slender, tibiotarsal articulation reaching to middle of eye. Toes long, slender, not fringed; in decreasing order of length 4–(5,3)–2–1. Outer metatarsal tubercle ovoid and prominent, inner metatarsal tubercle small.

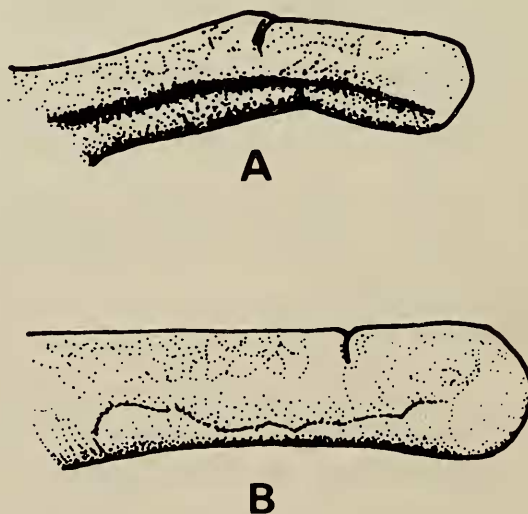


Fig. 3. Lateral profile of the fourth toe of *Eupsophus roseus* (A) and *E. calcaratus* (B).

Table 1.—Measurements (mm) of *Eupsophus calcaratus* from Puntra (Chiloé Island) population.

Character	7 males		24 females	
	Range	$\bar{x} \pm S.D.$	Range	$\bar{x} \pm S.D.$
Snout-vent length	31.4–35.2	32.9 $\pm$ 1.2	41.2–33.7	37.3 $\pm$ 2.0
Thigh length	15.1–17.0	16.0 $\pm$ 0.6	16.0–20.2	18.0 $\pm$ 1.0
Tibia length	16.6–18.8	17.4 $\pm$ 0.9	18.1–20.7	19.5 $\pm$ 0.6
Foot length	23.2–27.9	24.8 $\pm$ 1.5	25.0–29.8	28.0 $\pm$ 0.6
Head width	12.6–14.6	13.5 $\pm$ 0.8	13.3–15.9	14.5 $\pm$ 0.6
Head length	11.0–12.2	11.4 $\pm$ 0.4	11.7–13.8	12.9 $\pm$ 0.5
Eye diameter	3.2–4.3	3.7 $\pm$ 0.4	3.6–4.7	4.1 $\pm$ 0.3
Eye-nostril distance	2.8–3.1	3.0 $\pm$ 0.1	3.0–3.8	3.3 $\pm$ 0.2
Interorbital distance	2.6–3.3	2.9 $\pm$ 0.3	2.4–4.1	3.0 $\pm$ 0.4
Nostril-snout distance	1.7–2.3	2.0 $\pm$ 0.2	1.8–2.7	2.2 $\pm$ 0.2
Tympanum diameter	1.8–2.3	2.0 $\pm$ 0.2	1.9–3.5	2.4 $\pm$ 0.4

Subarticular tubercles large, conical and prominent; supernumerary tubercles absent. Tarsal fold absent. Rudiment of web between fourth and third, and between third and second toes. Anal opening oriented transversely at dorsal level of thighs. Table 1 shows the variation of external measurements in this species.

Skin smooth, minute tubercles on head. Ventral surface of thighs without granular tubercles, sometimes with minute tubercles. Two short cutaneous spurs at the heels and two dorsal linear ridges convergent behind, which are hardly noticeable. Minute tubercles on posterior part of flanks. Dorsum dark gray, with a remarkable pattern like a butterfly or hourglass extending from head, between eyes, to middle of dorsum. On flanks a dark fringe reaching the eyes. Some specimens show a narrow mid-line. Minute dark spots lateral to the butterfly pattern; two rounded dark brown spots on lumbar area stand out on the background. Minute dark spots on whitish venter, most numerous on throat. Arms, thighs, shanks, and tarsi barred dark brown. In life, dorsum and limbs light brown, tan or gray, venter whitish. Markings on dorsum, venter and limbs dark brown or black, flanks sometimes light brown or dark orange and the spots brown. Upper part of iris bronze-yellow, lower part dark brown.

*Eupsophus insularis* (Philippi, 1902)

Fig. 1

*Cystignathus (Borborocoetus) insularis* Philippi, 1902:89 (Chile; type-locality: Mocha Island). (Holotype lost)

*Eupsophus grayi* Cei, 1958:271.

*Eupsophus grayi insularis* Capurro, 1963:5–18.

*Diagnosis.*—*Eupsophus insularis* is a moderate sized species that can be distinguished from its congeners by the following combination of characters: 1) dark brown in color with irregular yellow spots on the dorsum and legs; 2) xiphisternum truncated and slightly notched; 3) prevomerine teeth below the choanae.

*Description* (based on 3 fixed specimens).—Head wider than long. Snout slightly truncate in lateral profile and pointed in dorsal view; canthus rostralis well defined; loreal region flat. Nostrils lateral, closer to tip of snout than to orbit;

Table 2.—Measurements (mm) of *Eupsophus insularis*.

Character	MUZUC no.		
	5256	5309	5299
Snout-vent length	40.90	38.20	38.70
Thigh length	20.50	18.10	17.85
Tibia length	22.00	21.35	20.15
Foot length	32.65	32.65	27.65
Head width	15.45	16.10	15.60
Eye diameter	5.25	4.30	4.25
Eye-nostril distance	3.20	3.45	3.20
Interorbital distance	3.45	3.70	3.30
Nostril-snout distance	3.00	2.05	2.15
Tympanum diameter	2.85	2.35	2.05

length of eye greater than distance between eye and nostril; internarial distance slightly smaller than interorbital distance. Tympanum diameter half the eye diameter. Well developed fold extending from behind eye to insertion of arm. Tongue rounded, without notch at the tip, posterior two thirds free. Small, round choanae; dentigerous process of prevomers lying medial and below choanae, separated medially, slightly oblique, each process bearing 6–7 teeth. Forelimbs thin; first finger equal in length to second; third finger much longer than fourth; digital length in decreasing order 3–4–2–1. Palmar webbing absent; tips of fingers slightly rounded and prominent. Inner median palmar tubercle ovoid; outer palmar tubercle round; subarticular tubercles rounded and of moderate size; supernumerary palmar tubercles absent. Hind limbs slender. Toes long, slender, and moderately fringed; tips of toes rounded; third and fifth toes equal in length, toes in decreasing order of length 4–(3,5)–2–1. Outer metatarsal tubercle small and rounded; inner metatarsal tubercle ovoid and prominent. Subarticular tubercles prominent and rounded; supernumerary tubercles absent. Tarsal fold absent. Toes without webbing. Anal opening oriented transversely, at dorsal level of thighs.

Skin smooth on dorsal and ventral surfaces; posteroventral areas of thighs with flat tubercles. Dorsum and legs brown with yellow, minute, irregular spots; venter yellowish and throat with dark brown irregular spots. Color of ventral surface of thighs similar to the belly. Arms marbled.

*Variation*.—Table 2 summarizes the variation in proportions of the three specimens examined. Two (MUZUC 5256, 5299) of the three specimens examined show the same color pattern, but the third (MUZUC 5309) has large, yellow, irregular spots on the dorsum, arms and shanks; and a light triangle on the head that extends from the interorbital area to the snout. The belly and the throat of this specimen are light brown.

### Comparisons

In habitus, size, and dorsal pattern, *E. calcaratus* is similar to *E. roseus*; however the species show external differences. *Eupsophus calcaratus* has the upper part of the iris bronze-yellow colored and the belly is whitish with minute, irregular dark spots; *E. roseus* has the ventral area transparent or whitish and

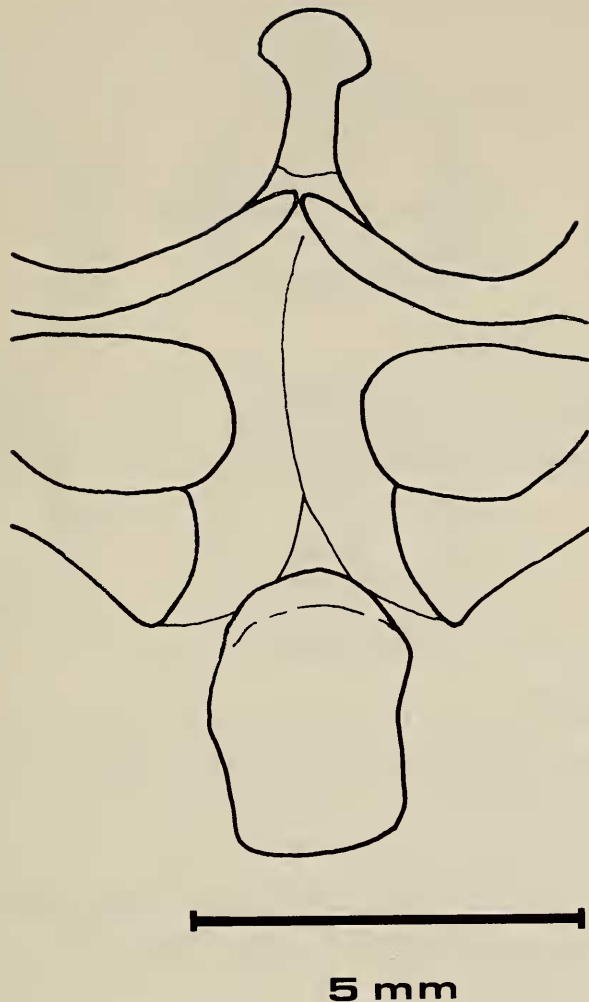


Fig. 4. Pectoral girdle of *Eupsophus insularis*.

the upper part of the iris is orange colored. *Eupsophus calcaratus* and *E. migueli* have the same color in the upper part of the iris, but the species are different in ventral color pattern; the belly of *E. migueli* is wine with irregular white spots. *Eupsophus insularis* has a dorsal color pattern (dark brown with yellow irregular spots) that is not present in the other species of the genus; this agrees with the color description given by Capurro (1963). This species has the xiphisternum slightly notched as in *E. migueli*, but in the latter the notch is greater (Fig. 4). On the basis of this character, *E. insularis* and *E. migueli* differ from the remaining species of the genus, *E. vittatus* and *E. roseus*. In *E. insularis* the prevomerine teeth are much more below the choanae than in the other *Eupsophus* species. *Eupsophus insularis* is a frog of moderate size ( $\bar{x} = 39.3$  mm) as are *E. calcaratus* ( $\bar{x} = 35.1$  mm), *E. roseus* ( $\bar{x} = 36.0$  mm; Ceï 1962) and *E. migueli* ( $\bar{x} = 35.5$  mm; Formas 1978). All these are remarkably smaller than *E. vittatus* ( $\bar{x} = 59.4$  mm; Grandinson 1961).

Twenty skulls of *E. roseus* and *E. calcaratus* and one skull of *E. insularis* were examined. Although *E. roseus*, *E. insularis* and *E. calcaratus* share the same cranial pattern (Fig. 5), qualitative differences were detected. The latter species has the prevomer bones in median contact and the sphenethmoid extends anterior to the nasals. The nasal bones show a tendency to be in median contact. The

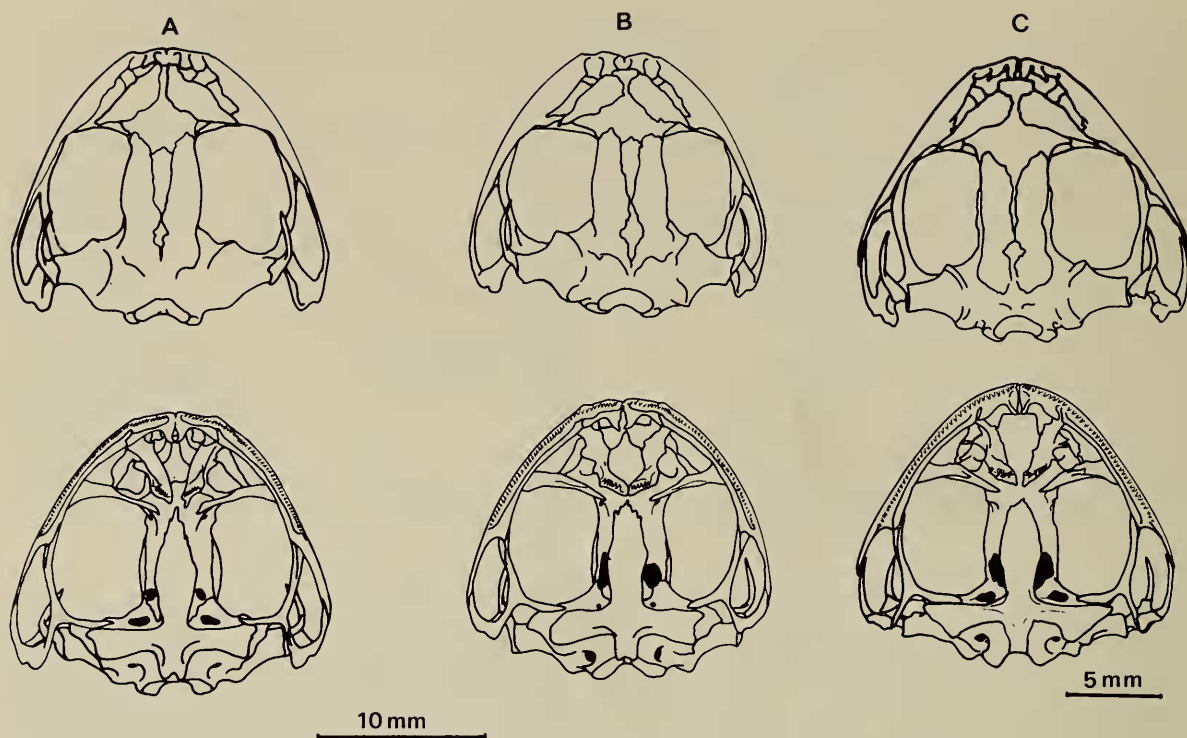


Fig. 5. Dorsal and ventral views of the skulls of *Eupsophus roseus* (A), *E. calcaratus* (B) and *E. insularis* (C).

prevomers of *E. roseus* are separated and the sphenethmoid reaches and sometimes slightly exceeds the anterior border of the nasals. The anterior end of the cultriform process of *E. insularis* does not reach between the palatines.

#### Natural History

Observations of *E. calcaratus* were made at Puntra, Chiloé Island (42°03'S, 73°48'W). A male was observed at night when it was calling at the border of a stream (air temperature 5°C) on 15 September 1980. In the same place we also recorded the mating call of *E. vittatus*. Females (8) with white-creamy ovarian eggs (59–168) were found on 28 July 1981. Adults males, females, and juveniles were collected under logs in a Chiloé *Nothofagus* forest on 15 September 1980 and found under logs outside the forest on 28 July 1981. Other herpetozoa found in the same area were the small lizard *Liolaemus pictus* and the frogs *E. vittatus*, *Batrachyla taeniata* and *Batrachyla leptopus*.

The three specimens of *E. insularis* are females, collected at the end of summer (14 March 1971). Two of these frogs have creamy-white ovarian eggs (119 in MUZUC 5256). MUZUC 5309 is immature.

#### Specimens Examined

*Abbreviations.*—Instituto de Zoología, Universidad Austral de Chile (IZUA), Museo de Zoología, Universidad de Concepción (MUZUC).

*Eupsophus calcaratus*: Chiloé Island: IZUA 1826–1856, Puntra; 1888–1907 (skeletons), Yaldad; 1908, Caulín; 1909–1910, Huillinco; 1911, Coquiao; 1912–1914, San Juan; 1916–1917, Quetalco; 1918, Mocopulli; 1919, Castro; 1920, Terao.

Valdivia Province: 1779–1783, Cordillera Pelada. Osorno Province: 973, 1582–1583, La Picada; 1754–1755, Antillanca.

*Eupsophus roseus*: San Martín Forest, Valdivia Province; IZUA 1857–1887; 1529–1533 (skeletons); 1691–1692 (skeletons); 1964–1968 (skeletons); 1700–1702 (skeletons); 1922–1926 (skeletons).

*Eupsophus insularis*: Mocha Island: MUZUC 5256, 5309, 5299.

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